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Effects of the jet fan air velocity response strategy and fire source location on the immersed tunnel fire smoke control

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Key words:

Immersed tunnel; Longitudinal temperature decay; Longitudinal carbon monoxide distribution; Tunnel fire; Reversible jet fan air velocity

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Smoke spreading process

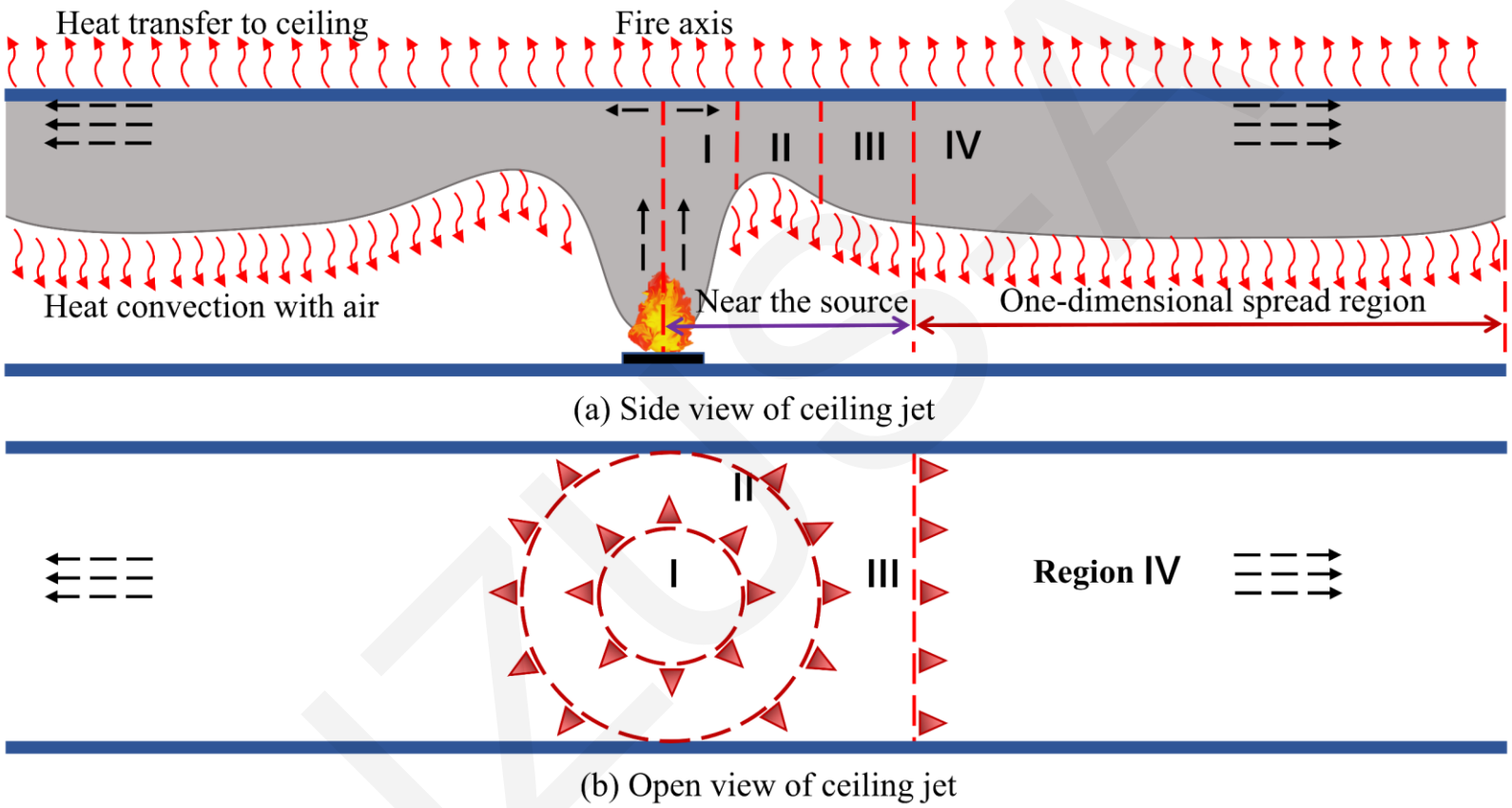


Fig.1 Tunnel smoke flow diagram

Ventilation method: positive ventilation in the upstream and reverse ventilation in the downstream (P-R)

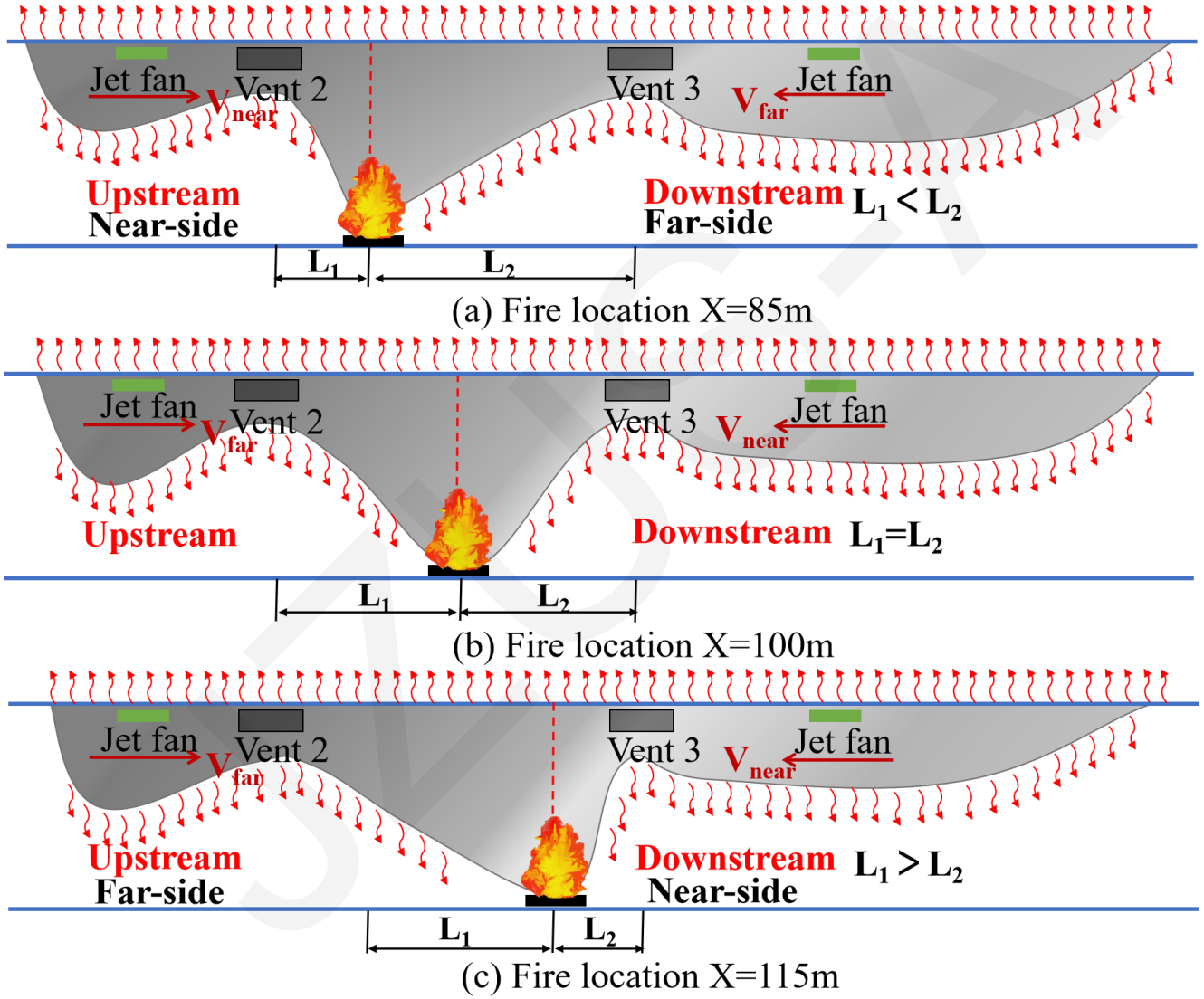
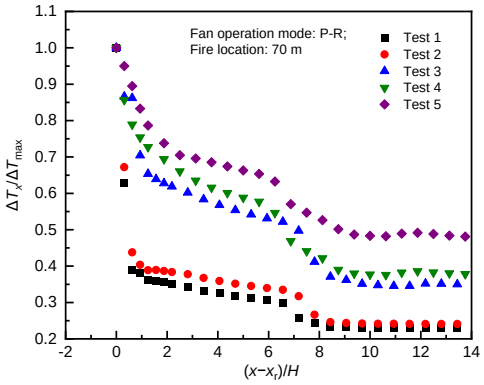
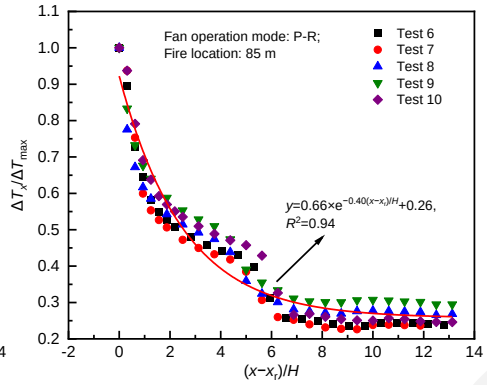
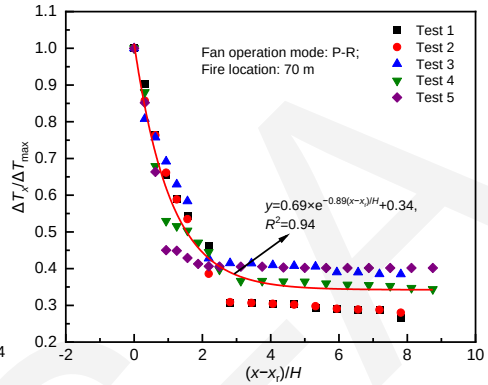


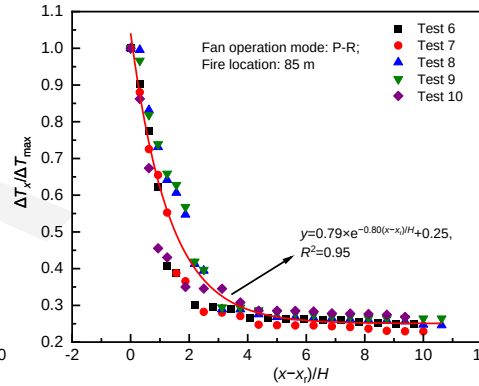
Fig. 2 Schematic diagram of the near-side and far-side of the smoke vent

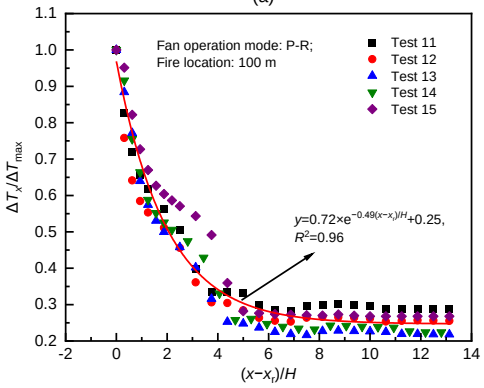
Longitudinal distribution of tunnel ceiling temperature

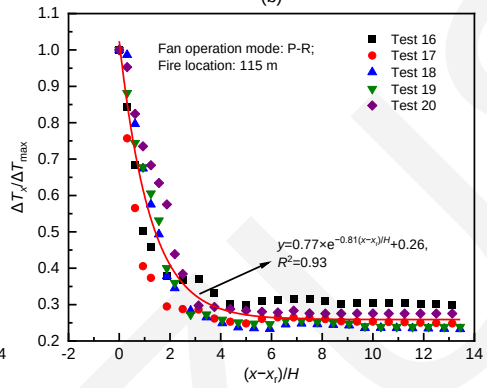


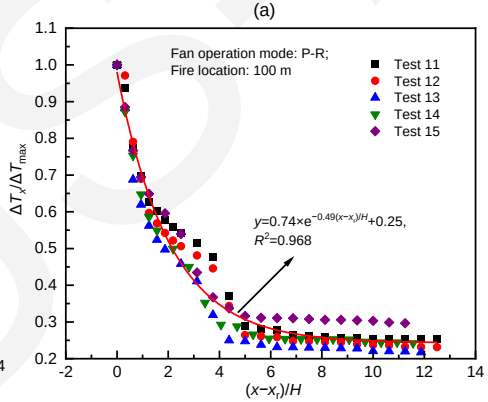


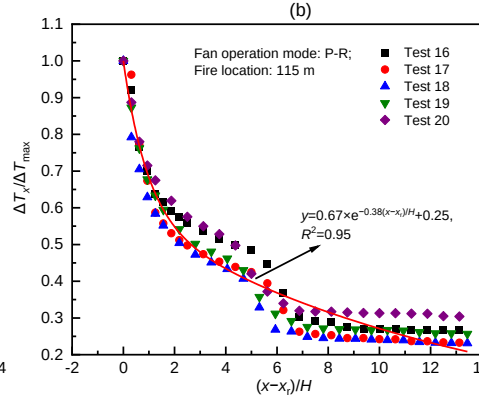


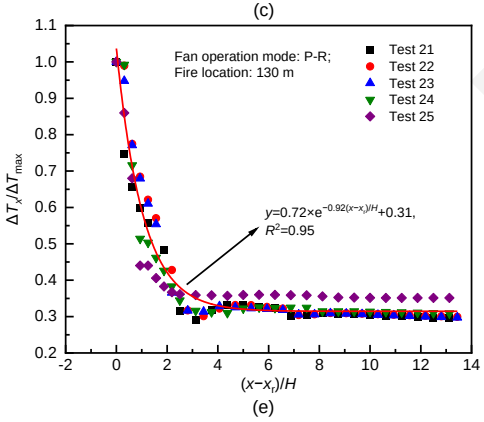












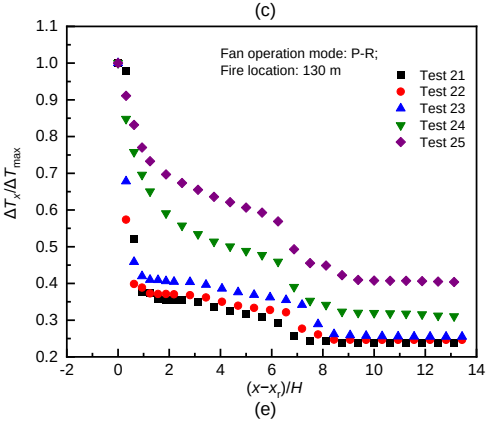


Fig. 3 Upstream and downstream temperature decay

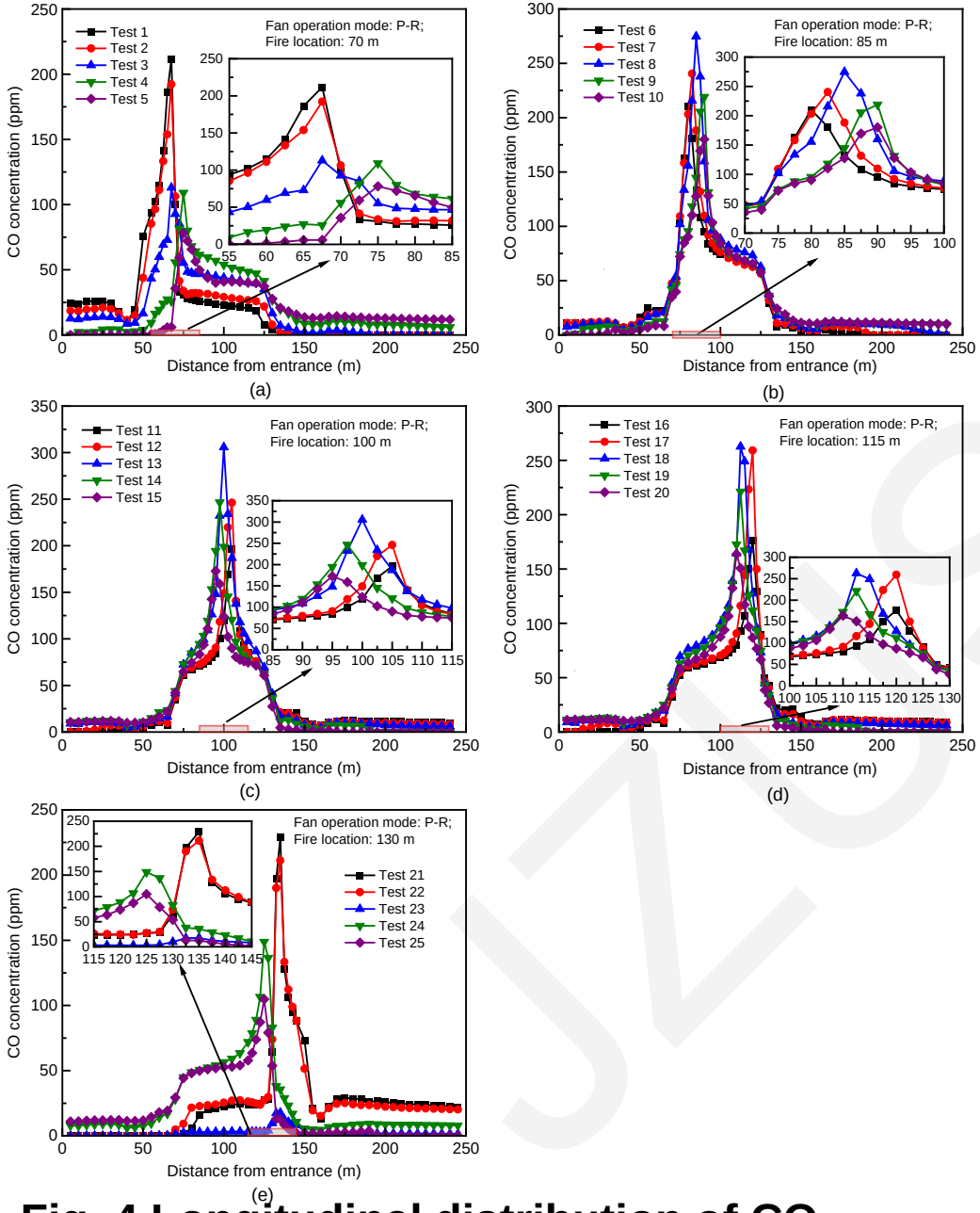


Fig. 4 Longitudinal distribution of CO concentration in the tunnel ceiling

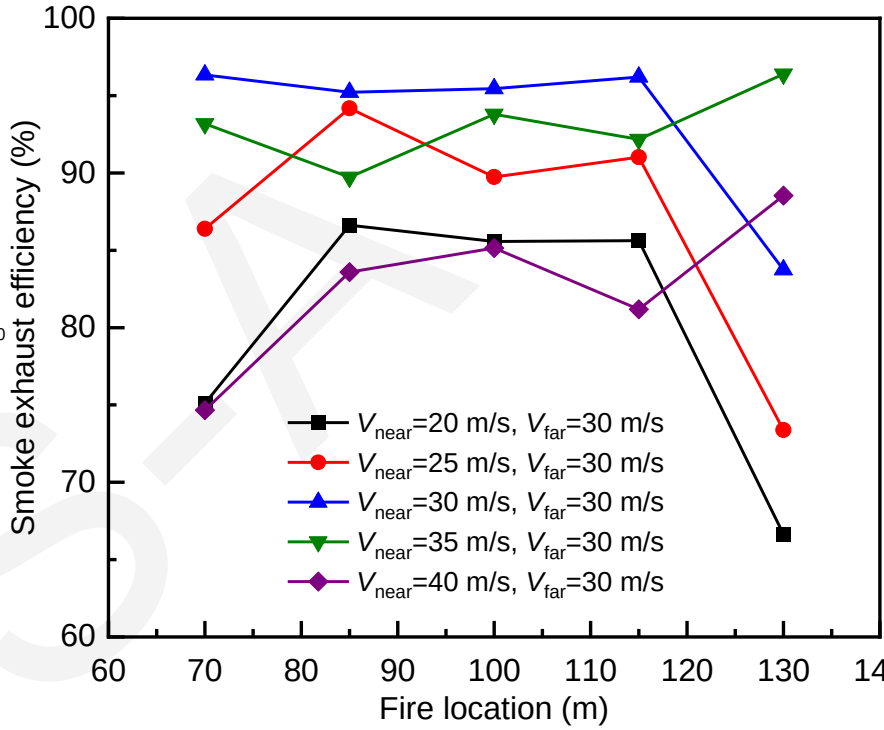


Fig. 5 Smoke exhaust efficiency with different jet fan air velocities

Conclusions

(1) The fire's flame will tilt to the side where the jet fan's air velocity is smaller. The velocity of the jet fan near the smoke vent should be regulated in accordance with the distance between the fire source and the smoke vent. Appropriate reduction of the air quantity pushed by the jet fan near the smoke vent can effectively mitigate the phenomenon of smoke settling.

(2) The temperature decay in the tunnel ceiling follows an exponential decay law. The temperature decay rate of the near side of the smoke vent is significantly higher than that of the far side. Accordingly, we proposed temperature decay models of the near side and far side of the smoke vents. The models suggested that there is a sudden drop in ceiling temperature and CO concentration at the smoke vent location.

(3) For the selected operating conditions, the jet fan air velocity of 25 m/s on the near side of the smoke vent is ideal. The average smoke exhaust efficiency was 87% for this setting, and the maximum smoke exhaust efficiency was also high at 95%.